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October 2011

Abstract

This paper compares two policies: trade cost reduction and firm relocation cost reduction using a three-country version of a heterogeneous-firms geography and trade model, where the three countries have different market (population) sizes. We show how the effects of the two policies differ, in particular for the country of intermediate size. Unless the intermediate country is very small, in a relative sense, it will gain industry when relocation costs are reduced, but lose industry when trade costs are reduced. The smallest country loses industry in both cases, but only experiences lower welfare in the case of lower relocation costs. Thus, the ranking of the policies from the point of view of the two small and intermediate countries tends to be the opposite.

JEL Classification: F12, F15, F21, R12

Keywords: agglomeration, firm heterogeneity, multi-country model, trade liberalisation, relocation costs

1 Introduction

World-wide economic integration, often called globalisation, makes it easier to trade goods and, in many cases, makes it easier to set up plants and establishments in foreign countries. Models of economic geography and trade have focused on the effects of lower trade costs. They show how industries agglomerate to large core countries as trade costs are reduced (see e.g. Baldwin et al. 2003 and Fujita and Thisse 2002 for a survey). The analysis is generally performed in a two-country setting, but similar conclusions apply in a multi-country setting.[1]

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[1]For a multiregion analysis, see e.g. Baldwin et al. (2003, ch. 14), Forslid (2011), Krugman and Livas (1996) and Puga and Venables (1996). Ago et al. (2006) show how industry may relocate towards the smallest region

More recent theoretical research has introduced heterogeneous firms in the models of economic geography and trade. There is a large empirical literature documenting how firms are heterogeneous in various dimensions. Exporting firms are e.g. larger, more productive and more capital intensive than non-exporters (see e.g. Bernard et al. 2007a,b). These findings are consistent with the theoretical literature showing how only the most productive firms are selected to exporting (see Melitz, 2003 and Helpman et al. 2004). The literature also shows how economic integration increases the selection effects. Economic integration forces the least productive firms to exit, as foreign competition increases. The selection may also take place across space. Baldwin and Okubo (2006) show how lower trade costs lead to spatial selection (sorting) with the most productive firms in the larger countries and the less productive firms in the periphery. Several empirical studies have also documented how selection effects lead to higher average firm productivity in large markets (see e.g. Combes, et al. 2009; Gatto, et al. 2008; Syverson 2004, 2007).[2]

An important example of far reaching economic integration is the European Union. The focus here has been as much on lower barriers to the free mobility of production factors, such as labour and capital, as on lower trade costs for goods.[3] This paper focuses on how the locational effects of economic integration differ between a reduction of trade costs and a reduction of relocation costs of capital (firms).[4] For this purpose, we use a three-country trade and location model with heterogeneous firms a la Baldwin and Okubo (2006). The novelty of the paper lies both in the comparison of trade liberalisation to lower relocation barriers of firms and in the fact that we analyse location in a multi-country (three-country) economic geography model with heterogeneous firms, which allows us to account for spatial selection (sorting) of firms.

The paper uses a model with a large, an intermediate and a small country. In addition to lower trade costs, we analyse economic integration in the form of lower relocation costs. Relocation costs in our model are any costs associated with the geographical movement of a production facility such as e.g. regulatory barriers.[5] Our analysis shows how the collapse of all industry to the core may be specific for two-country models analysing economic integration in the form of lower trade costs only. We show that, contrary to trade liberalisation, lower

because of severe price competition in the larger markets when using the linear-demand monopolistic competition model of Ottaviano et al. (2002).

[2] There is also a body of literature rooted in economic geogrphy showing that workers and firms are on average more productive in larger markets (Head and Mayer, 2004; Redding and Venables, 2004; and Amiti and Cameron, 2007).

[3] The first 'pillar' of the Maastricht Treaty includes the Internal Market with its four freedoms: free movement of goods, services, workers and capital, as well as the Single Market Programme including harmonisation of standards.

[4] Okubo and Rebeyrol (2006) analyse a fall in relocation costs but use a two-country framework.

[5] Relocations costs could also encompass such phenomena as a malfunctioning housing market that makes it difficult to establish a factory in a new location.

relocation costs can lead to firm relocation into both the large and the intermediate country.[6] More specifically, we find that lower *trade costs* tend to produce the usual concentration of economic activity to the core (large) country in our model. That is, industry from all countries moves towards the core. Despite this, welfare increases for all countries as a result of trade liberalisation.[7] Lower *relocation costs* also lead to an increased concentration to the core but, unless the intermediate country is very small, it is only firms from the smallest country that move there. The intermediate country actually gains industry as a consequence of lower relocation costs. Welfare increases for the large and intermediate countries, whereas the small country that loses industry experiences declining welfare in this case.

A policy implication of our analysis is that European countries of intermediate size, in particular, may benefit from free mobility of production factors within the EU. Turning to development strategies of poor countries, our analysis indicates that intermediate size developing countries may be better served by focusing on FDI than on trade. Lower barriers to FDI would lead to an inflow of industry, whereas lower trade costs could lead to the opposite. Our model could also be applied to a regional context within a country, where trade costs are interpreted as transportation costs only. An interpretation of our results, from a regional perspective, is that the long-run prospects of regional centers outside the largest core regions could be upgraded as a result of lower relocation costs.

2 The Model

We use a multi-country version of the Baldwin and Okubo (2006) model, which is based on the Melitz (2003) heterogeneous firms model with the 'footloose capital' geography and trade model by Martin and Rogers (1995).

2.1 Basics

There are n countries with an asymmetric population (market size). Countries are ordered so that *Country* 1 is the largest and *Country* n the smallest. There are two types of factors of production, capital and labour, and each country has the same proportion of capital to labour. That is, countries are identical except for size. Capital, which is sector specific, can move between countries but capital owners do not. Labour can move freely between sectors but are immobile between countries. A homogeneous good is produced with a constant-returns technology only using labour. Differentiated manufactures are produced with increasing-returns technologies using both capital and labour.

[6] We show these results in a model with heterogeneous firms, but qualitatively similar results would be obtained if firms were homogeneous.

[7] Our results on trade liberalisation are related to those of Gopinath, Saito and Wu (2011) who analyse the effects of preferential trade liberalisation in a setting with two domestic regions trading with the outside world. They use a model with heterogeneous firms in a linear demand setting, and do not analyse the effects of lower relocation costs.

All individuals have the utility function

$$U = C_M^{\mu} C_A^{1-\mu}, \quad where \quad C_M = \left[\int_{l \in \Psi} c_l^{(\sigma-1)/\sigma} dl \right]^{\sigma/(\sigma-1)} \tag{1}$$

where $\mu \in (0,1)$, $\sigma > 1$ are constants and Ψ is the set of consumed variety. C_M is a consumption index of manufacturing goods and C_A is consumption of the homogeneous good. c_l is the amount consumed of variety l. Country subscripts are suppressed when possible for ease of notation.

Each consumer spends a share μ of his income on manufactures. Total demand for a domestically produced variety i is

$$x_i = \frac{p_i^{-\sigma}}{\int_{l \in \Psi} p_l^{1-\sigma} dl} \cdot \mu Y, \tag{2}$$

where p_l is the price of variety l and Y **is** income in the country.

Turning to the supply side, the homogeneous good sector is a constant returns and perfect competition sector. The unit factor requirement of the homogeneous good is one unit of labour. The good is freely traded and since it is also chosen as the numeraire, we have

$$p_A = w = 1, \tag{3}$$

w being the wage of workers in all countries.

In the production of differentiated goods, firms have a firm-specific unit labour input coefficient (a) and uses one unit of capital, as in the standard footloose capital model. A fixed amount of capital endowments in the world lead to no entry and exit of firms, whilst international capital mobility allows firms to move between countries. The mass of differentiated firms is normalised to one, $N^W \equiv 1$. The total costs for firm i are specified as

$$TC_i = \pi_i + a_i x_i, \tag{4}$$

where π is return to capital. The variable cost consists of labour. Importantly, firms are heterogeneous and their firm-specific marginal production costs a_i are distributed according to the cumulative distribution function $F(a)$.

Geographical distance is represented by trade costs. Shipping the manufactured good involves a frictional trade cost of the "iceberg" form: for one unit of good from country j to arrive in country k, $\tau_{jk} > 1$ units must be shipped. Trade costs are symmetric between all countries $\tau_{jk} = \tau \ \forall \ j, k$.

Profit maximisation by manufacturing firms leads to a constant mark-up over marginal cost

$$p_i = \frac{\sigma}{\sigma - 1} a_i, \tag{5}$$

and the export price is $p_i \tau_{jk}$, taking the iceberg trade costs into account.

Ownership of capital is assumed to be fully internationally diversified; that is, if one country owns X-percent of the world capital stock, it will own X-percent of the capital in each country.

Therefore, the income of each country is constant and independent of the location of capital. World expenditure equals world factor income. Firms' fixed factor of production is capital and the variable factor is labour. The return to capital therefore equals firms' operating profit in equilibrium. Thus, world expenditures can be written as $E^W = wL^W + rK^W = wL^W + \mu E^W/\sigma$.[8] Without loss of generality, we choose units so that $L^W \equiv 1$, which gives $E^W = \frac{1}{1-\mu/\sigma}$. The income of country j is equal to its share of world expenditures given by

$$Y_j = s_j E^W = s_j \frac{\sigma}{\sigma - \mu}, \tag{6}$$

where s_j is country j's share of world endowments and world expenditures. Y_j is thus constant irrespective of the location of capital; i.e. also out of long-run equilibrium.

2.2 Short-run equilibrium

In the short-run equilibrium, the allocation of capital in each country is taken to be fixed. s_j denotes the share of capital and the number (mass) of firms in *Country j* since one unit of capital corresponds to one firm, and since $N^W = 1$.

Firm heterogeneity in labour requirements, a_i, is probabalistically allocated among firms. In order to analytically solve the model, we assume the following cumulative density function of a:

$$F(a) = \frac{a^\rho - \underline{a}^\rho}{a_0^\rho - \underline{a}^\rho}, \tag{7}$$

where ρ is a shape parameter and a_0^ρ is a scaling factor.[9] We assume the distribution to be truncated at $\underline{a}$, where $0 < \underline{a} < a_0$, so that the productivity of firms is bounded, and we normalise so that $a_0 = 1$.

The return to capital of a firm in country j is the firm's operating profit,

$$\pi_j(a_i) = \frac{a_i^{1-\sigma}}{(\sigma - \mu)} \mu \left(\frac{s_j}{\overline{\Delta_j}} + \sum_k \phi_{jk} \frac{s_k}{\overline{\Delta_k}} \right), \tag{8}$$

where the right-hand side follows from the demand functions in (2) and

$$\overline{\Delta_j} \equiv s_j \int_{\underline{a}}^{1} a_i^{1-\sigma} dF(a) + \sum_k \phi_{jk} s_k \int_{\underline{a}}^{1} a_i^{1-\sigma} dF(a). \tag{9}$$

The object $\phi_{jk} \equiv \tau_{jk}^{1-\sigma}$, ranging between 0 and 1, stands for "free-ness" of trade between countries j and k (0 is autarky and 1 is zero trade costs). It is assumed that the labour stock is sufficiently large so that the homogenous sector, which pins down the wage, is active in all countries.

[8] Note that a firm's operating profit is sales divided by σ, since $p_i x_i - a_i x_i w = p_i x_i - \frac{\sigma-1}{\sigma} p_i x_i = \frac{p_i x_i}{\sigma}$.

[9] This is essentially a Pareto distribution that has been truncated.

Consider now what would happen if firms were allowed to move between countries. From (8), the firms' return to capital is convex and falling in a_i. Firms with the highest labour productivity (the lowest a_i) have the largest profits and will be the most sensitive to market size and thus have the strongest incentives to move to the large market. Under reasonable assumptions of moving costs, this would lead to sorting with the most productive firms in the larger market, as shown by Baldwin and Okubo (2006).

More formally, a firm will move from k to j when

$$\pi_j(a_i) - \pi_k(a_i) - \chi = \frac{a_i^{1-\sigma}}{(\sigma - \mu)}(1-\phi)\mu\left(\frac{s_j}{\overline{\Delta}_j} - \frac{s_k}{\overline{\Delta}_k}\right) - \chi > 0, \tag{10}$$

where χ is a per-unit of capital fixed relocation cost and trade costs are assumed to be symmetric.[10]

In the following, we proceed with a three-country analysis and symmetric trade costs, which is the simplest structure that enables us to focus on countries of intermediate size. Country 1 has the largest population, Country 2 is of intermediate size and Country 3 has the smallest population ($s_1 > s_2 > s_3$).

2.3 Relocation tendencies

Before moving to the full long-run solution of the model, we consider the relocation incentives faced by firms starting out from the initial equilibrium. Figure 1 shows $\pi_j(a_i) - \pi_k(a_i)$ for all country pairs.

Note that we rule out that firms have infinite productivity by assuming a to be bounded from below at $\underline{a}$.[11] The incentive to relocate increases in firm size as well as in the market size difference between two countries. Higher productivity firms are more sensitive to market size difference and have stronger incentives to move to large markets. The largest size difference corresponding to the highest curve in Figure 1 is always between the largest and the smallest country. Then, the curves will be ordered depending on the relative size of countries.

The effects of relocation costs can be seen from Figure 1. For a high moving cost, as illustrated by line χ_0 in the figure, only the most productive firms from Country 3 will migrate to Country 1. As relocation costs are reduced, relocation will take place between more countries. The extent of relocation between different countries will depend on their relative size.

When turning to the long-run equilibrium, firms start to move and we need to explicitly model the dynamics. With many countries, there will in general be a simultaneous relocation between several country pairs.

[10] This specification differs from that of Baldwin and Okubo (2006) where the relocation cost is a function of the migration pressure.

[11] No bounded fixed moving cost per unit of capital would be sufficiently high to prevent the infinitely productive firms from moving.

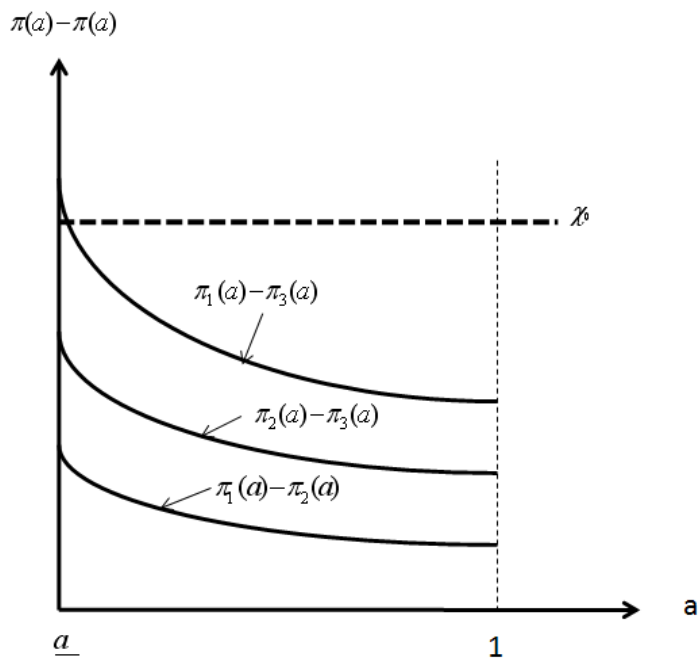

Figure 1: Profit differentials between countries

2.4 Long-run equilibrium

In the long-run equilibrium, capital is fully mobile between countries and responsive to the incentives provided by the relative returns that can be obtained in the three countries.[12] Thus, firms are mobile internationally. However, note that capital owners are bound to their country of origin and capital rewards are therefore repatriated to the country of the owners. The value of relocation to a larger market is highest for the most productive firms since they have higher sales and are better equipped to cope with the higher competition in the large market. Relocation therefore starts from the high end of the productivity distribution. Generally, the value of migrating for a firm depends on its own marginal cost and the mass of firms that have already migrated. Suppose now that firms migrate in productivity order so that all firms that are more productive than the marginal relocating firm have already migrated (in the next section, we will make assumptions for this to be the case). The value of migrating from one of the smaller markets (Country k) to a larger market (Country j) at a certain point in time, when no other bilateral migration takes places, is in this case

$$v_{kj}(a_{Rk}) = \pi_j(a_{Rk}) - \pi_k(a_{Rk}) - \chi = \frac{a_{Rk}^{1-\sigma}}{(\sigma-\mu)}(1-\phi)\left(B_j - B_k\right) - \chi, \tag{11}$$

where

[12] Profit maximisation ensures that capital is located where its return is maximised.

$$
\begin{aligned}
B_j &\equiv \frac{s_j}{\Delta_j(a_{Rk})}, \quad B_k \equiv \frac{s_k}{\Delta_k(a_{Rk})}, \qquad (12)\\
\Delta_j(a_{Rk}) &\equiv s_j \int_{\underline{a}}^{1} a^{1-\sigma} dF(a) + \phi(1-s_j) \int_{\underline{a}}^{1} a^{1-\sigma} dF(a) + s_k(1-\phi) \int_{\underline{a}}^{a_{Rk}} a^{1-\sigma} dF(a),\\
\Delta_k(a_{Rk}) &\equiv s_k \int_{a_{Rk}}^{1} a^{1-\sigma} dF(a) + \phi(1-s_k) \int_{\underline{a}}^{1} a^{1-\sigma} dF(a) + s_k\phi \int_{\underline{a}}^{a_{Rk}} a^{1-\sigma} dF(a),
\end{aligned}
$$

and where a_{Rk} is the productivity (input coefficient) of the marginal relocating firm from country k, B_j is a measure of the average per-firm market size in market j that is independent of firm productivity, a_i, and Δ is closely related to the usual CES price index ($\Delta \equiv \left(\frac{\sigma-1}{\sigma}\right)^{1-\sigma} P^{1-\sigma}$).[13] The first term in Δ refers to domestically produced varieties, the second to imported varieties from all other countries, and the third to varieties that have moved to country j. (In the last term we subtract ϕs_k, which are varieties included in the second term that are not imported).[14]

The long-run equilibrium is determined by solving $v_{jk}(a_{Rj}) \leq 0$ for a_{Rj} for all country pairs. Naturally, the value of migrating is negative for all firms if the fixed moving cost χ is too high.

The relative size of countries will be of key importance in any multiple country setting. As mentioned above, we assume that $s_1 > s_2 > s_3$. As we will see, this implies that relocation will start from Country 3 to Country 1. The long-run implications for the intermediate country, Country 2, will depend on its relative size. To highlight market size differences, we assume ϕ to be the same between all country pairs.

3 The effect of reduced trade costs

Trade liberalisation (an increase in ϕ) affects the value of relocation. A difficulty when analysing trade liberalisation with many countries is that it may be that firms from one country move to two other countries simultaneously or that firms from two countries simultaneously move to a third country. When firms are heterogeneous, it becomes difficult to keep track of the sorting of firms when this occurs. To simplify the analysis, we assume in this section that, instead of a fixed relocation cost, there is a firm relocation cost à la Baldwin and Okubo (2006) that is related to the migration pressure. We assume the cost of moving to be given by:

[13] Solving the integrals (12) gives

$\Delta_j = \frac{\rho}{\rho-\sigma+1} \frac{1}{a_0^{\rho} - \underline{a}^{\rho}} \left[s_j \left(1 - \underline{a}^{\rho-\sigma+1}\right) + \phi(1-s_j)\left(1 - \underline{a}^{\rho-\sigma+1}\right) + s_k(1-\phi)\left(a_{Rk}^{\rho-\sigma+1} - \underline{a}^{\rho-\sigma+1}\right)\right],$

$\Delta_k = \frac{\rho}{\rho-\sigma+1} \frac{1}{a_0^{\rho} - \underline{a}^{\rho}} \left[s_k \left(1 - a_{Rk}^{\rho-\sigma+1}\right) + \phi(1-s_k)\left(1 - \underline{a}^{\rho-\sigma+1}\right) + s_k\phi\left(a_{Rk}^{\rho-\sigma+1} - \underline{a}^{\rho-\sigma+1}\right)\right].$

[14] We instead have $\Delta_j(a_R) \equiv s_j \int_{\underline{a}}^{1} a^{1-\sigma} dF(a) + \phi(1-s_j) \int_{\underline{a}}^{1} a^{1-\sigma} dF(a) + s_k(1-\phi) \int_{\underline{a}}^{a_{Rk}} a^{1-\sigma} dF(a) + s_l(1-\phi) \int_{\underline{a}}^{a_{Rl}} a^{1-\sigma} dF(a)$, in the case where firms from both smaller regions k and l migrate into the larger region j.

$$\chi = \kappa \left(\frac{dF(a_{R1})}{dt} + \frac{dF(a_{R2})}{dt} + \frac{dF(a_{R3})}{dt} \right) + \chi_0, \tag{13}$$

where κ and χ_0 are constants. The relocation cost is high when many firms move at the same time, but gradually declines to χ_0 as the migration pressure falls as we approach the equilibrium. These relocation costs may be considered as international freight rates. Firms bid for freight capacity to move their production equipment. The higher is the demand for transportation, the higher are the freight rates. The firm with the highest willingness to pay for transportation will be the firm with the most to gain from relocating. This set-up implies that the most productive firm is the first firm to relocate and that it moves to the location with the highest return. Moreover, it implies that as long as the gains from moving between country pairs are different, migration will take place only between the country pair where the gains from relocating are the highest.

3.1 The equilibrium path

Using the above logic, starting from autarky where firms are located in proportion to market size and liberalising trade, implies that the productive firms in the smallest country move to the other countries. Formally[15]

$$\frac{dv_{31}(a)}{d\phi} > \frac{dv_{21}(a)}{d\phi} > 0. \tag{14}$$

This implies that relocation starts by firms in Country 3 relocating to Country 1, as trade liberalisation starts from autarky. Furthermore, trade liberalisation implies that there is a fall in π_1 as firms move into Country 1. Would it then be the case that after a while, firms instead move to Country 2? The answer is no. The reason is that further trade liberalisation increases competition in Country 2 more than in Country 1, since a much larger share of the firms are already located in Country 1, which implies that trade liberalisation has a weaker effect on the price index in Country 1 than in Country 2. Formally[16]

$$\frac{dv_{31}(a_{R3})}{d\phi} > \frac{dv_{32}(a_{R3})}{d\phi} > 0. \tag{15}$$

This implies that it is more profitable for a Country 3 firm to relocate to Country 1 than to Country 2. This relocation pattern is illustrated in the left-hand part of Figure 2 for a small χ_0.[17] Further liberalisation affects the profit differentials according to: $\frac{d^2 v_{31}(a_{R3})}{d\phi^2} < \frac{d^2 v_{21}(a_{R2})}{d\phi^2} < 0$, and at ϕ' where $\frac{dv_{31}(a_{R3})}{d\phi} = \frac{dv_{21}(\underline{a})}{d\phi} > 0$ (for $a_R > \underline{a}$) relocation also starts from Country 2 to 1.[18] This is also the sustain point for Country 3, where firms stop moving out of Country 3, and

[15] A proof is found in section 6.1 in the appendix in Forslid and Okubo (2011).

[16] A proof is found in section 6.1 in the appendix in Forslid and Okubo (2011).

[17] Relocation will stop before full agglomeration if χ_0 is large.

[18] See section 6.1 in the appendix in Forslid and Okubo (2011).

migration continues from Country 2 to Country 1 only. The sustain point for Country 3 can be calculated when $\chi_0 = 0$. It is in this case given by $\phi^{'} = \frac{s_3}{1-2s_3}$.(Note that $v_{31}(a_{R3}) = v_{32}(a_{R3})$ in equilibrium when $\chi_0 = 0$, since the relocation costs related to congestion go to zero as the relocation of firms stops.)

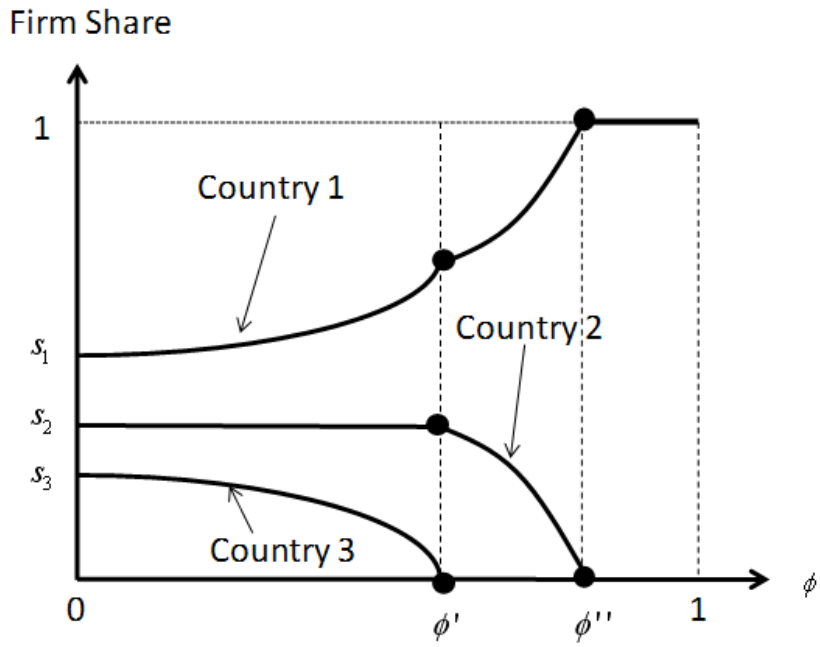

Figure 2: The effect of trade liberalisation

This relocation pattern in this case is, in a qualitative sense, very similar to the standard footloose capital model with three countries.[19]

3.2 Long-run welfare effects of reduced trade costs

As is customary in the international trade literature, we will here consider long-run welfare and therefore ignore costs associated with restructuring or relocation. In the case of homogeneous firms, the small and intermediate countries will always gain from trade liberalisation despite losing their entire manufacturing industry.[20] Here, we consider heterogeneous firms and the long-run welfare consequences are therefore potentially different because of the sorting of the least productive firms to the periphery. For analytical clarity we maintain the assumption that $\chi_0 = 0$.

The long-run welfare of country j could be measured by real income, $\frac{Y_j}{P^{\mu} p_A^{1-\mu}}$. The trade cost reduction has two effects on welfare. It reduces the price of imports, which is always positive for welfare, but it also leads to an outflow of firms for the smaller countries, which is negative

[19] See e.g. Forslid (2011).

[20] See e.g. Forslid (2011).

for welfare since these varieties must now be imported.

$Y_j = s_j \frac{\sigma}{\sigma-\mu}$ from (6). The income of a country is constant since the ownership of capital is fully internationally diversified and since $w = p_A = 1$. Therefore, it suffices to study the price index, $P_j = \left(\frac{\sigma}{\sigma-1}\right) \Delta_j^{\frac{1}{1-\sigma}}$, to compare the long-run welfare between countries. Formally, $\frac{\partial \Delta_3}{\partial \phi} > 0$, implying that the small country will always gain from trade liberalisation in spite of losing its industry.[21] That is, the effect of cheaper imports always outweighs the effect of the outflow of industry. The same logic applies for the country of intermediate size which will gain from trade liberalisation even during the final phase of trade liberalisation when it loses its industry to the core country.

Next, we turn to the effects of reduced relocation costs. As will be seen, these effects can be very different than for reduced trade costs.

4 The effect of reduced relocation costs

Here, we discuss the general effects of reduced relocation costs keeping trade costs fixed. In contrast to the previous section, where relocation costs gradually declined as the migration pressure disappeared in equilibrium, we here assume χ to be a policy parameter.[22] In the following subsections, we derive the critical levels of relocation costs where relocation changes nature (the *sustain* and *bifurcation* points).

4.1 The equilibrium path

Starting from a hypothetical situation with high relocation costs χ, where the $\chi-$line does not intersect with any of the profit differential curves in Figure 1, there will be no relocation. We also assume a given $\phi > \phi'$, so that firms do relocate when relocation costs fall (see Figure 2). Gradually reducing χ we reach a point where the $\chi-$line reaches the first profit-differential curve and relocation starts. The first firms to move are the most productive firms in the smallest country, which move to the largest country; thus, from Country 3 to Country 1. Further reductions in χ imply that successively less productive firms move. The relocation of firms into Country 1 reduces B_1 and thereby lowers the incentives to move to Country 1. Despite this, firms from Country 3 will never prefer to move to Country 2 instead of Country 1.[23]

The marginal firm in Country 3 at equilibrium, a_{R3}, is defined by the condition that

$$\frac{a_{R3}^{1-\sigma}}{(\sigma-\mu)}(1-\phi)\left(B_1 - B_3\right) = \chi. \tag{16}$$

The relocation of firms from Country 3 to Country 1, as relocation costs are reduced, will reduce B_1 as competition increases in Country 1 and, for the same reasons, it will increase

[21] A proof is found in section 6.2 in the appendix in Forslid and Okubo (2011).

[22] In terms of equation (13), we set $\kappa = 0$ and gradually reduce χ_0.

[23] As shown in section 6.3 in the appendix in Forslid and Okubo (2011).

B_3. However, B_2 and the profit of firms in Country 2 remain constant since the price index is unaffected when no firms relocate to or from Country 2 and when the trade costs are unchanged. That is, the prices of import goods in Country 2 are unchanged, even if firms relocate from Country 3 to Country 1, since the cost of import, determined by ϕ, is the same from both countries. This is illustrated in Figure 3, where the B_1 line falls and B_3 rises as successively as less productive firms relocate.

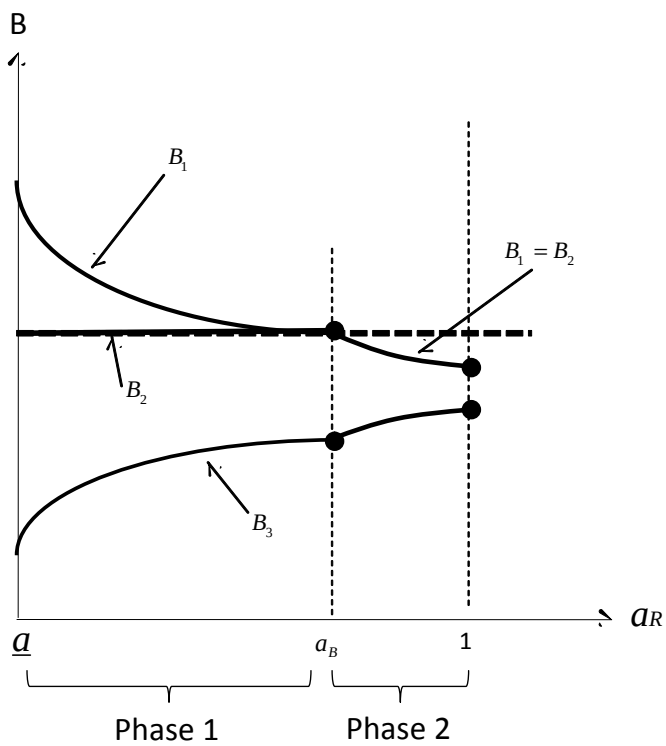

Figure 3: The effect of a lower relocation cost when the intermediate region is relatively large.

In the case illustrated in Figure 3, B_1 converges to B_2 while $B_3 < B_1 = B_2$. A sufficient condition for this to happen is that $s_1 - s_2 < s_2 - s_3$.[24] At the point where $B_1 = B_2$, we have that

$$\pi_1 - \pi_3 = \pi_2 - \pi_3 \tag{17}$$

since

$$\frac{a_{R3}^{1-\sigma}}{(\sigma-\mu)}(1-\phi)\left(B_1 - B_3\right) = \frac{a_{R3}^{1-\sigma}}{(\sigma-\mu)}(1-\phi)\left(B_2 - B_3\right) \quad for \quad B_1 = B_2. \tag{18}$$

[24] As shown in section 6.3 in the appendix in Forslid and Okubo (2011).

Countries 1 and 2 are then equally attractive for a potential relocating firm from Country 3, and relocation from Country 3 therefore goes to both Country 1 and Country 2 from this point onwards. Successively lower relocation costs will lead to a gradual relocation from Country 3 until no firms are left in that country. Further reductions in χ do not affect the location of firms as long as the relocation costs are positive since $B_1 = B_2$. The location pattern of firms as relocation costs, χ, are reduced is illustrated in Figure 4, where χ decreases along the x-axis.[25]

The effects of lower relocation costs are thus very different from the effects of reduced trade costs in the case where the intermediate country is not too small in relation to the other two countries ($s_1 - s_2 < s_2 - s_3$). The main difference lies in the outcome for the country of intermediate size. Lower trade costs lead to a concentration of industry from all countries to the largest country, whereas reduced relocation costs lead to a deindustrialisation of the smallest country only. Here, both the large and the intermediate country gain industry. The fundamental reason for this difference is that trade liberalisation always affects the price index of all countries and thus, the relative attractiveness of the countries. In contrast, reduced relocation costs only affect the price index of countries where firms move in and out.

Our interest lies in the case where $s_1 - s_2 < s_2 - s_3$, as illustrated in Figure 4. There are two phases in the relocation of firms to Country 1. In the first phase, firms from the small country relocate to the largest country only. Thereafter, in phase 2, when the point where $B_2 = B_1$ has been reached, relocation from Country 3 goes to both Country 1 and Country 2. When all industry has left Country 3, there is no more reallocation since there are positive reallocation costs, and since $B_2 = B_1$ with constant trade costs (constant ϕ).[26]

4.2 Long-run welfare effects of reduced relocation costs

Once more, the price index, $P_j = \Delta_j^{\frac{1}{1-\sigma}}$, can be used for comparisons of long-run welfare (where we ignore the relocation costs). The welfare analysis is simple in this case, since firm location is the sole factor affecting welfare with constant trade costs. The welfare effects of lower χ are different in the two phases. Starting with phase 1 when $B_1 > B_2 > B_3$, firms relocate from Country 3 to Country 1, resulting in $\frac{d\Delta_3}{d\chi} > 0$ and $\frac{d\Delta_1}{d\chi} < 0$. This implies that welfare increases in Country 1 and decreases in Country 3. During phase 2, when $B_1 = B_2$, firms move from Country 3 to both Country 1 and Country 2, resulting in $\frac{d\Delta_3}{d\chi} > 0$, $\frac{d\Delta_1}{d\chi} < 0$ and $\frac{d\Delta_2}{d\chi} < 0$. This implies that welfare increases in both Country 1 and 2 and decreases in Country 3.

The welfare implication of lower trade costs and lower relocation costs are thus very different for the smaller countries. The smallest country loses its industry in both cases, but experiences

[25] When the intermediate country is smaller so that $s_1 - s_2 > s_2 - s_3$, it will instead be the case that the system reaches a point where $B_3 = B_2 < B_1$ as relocation costs are reduced. At this point, relocation starts from both Country 2 and 3 towards Country 1. Thus, this case resembles the core-periphery outcome that is the result of trade liberalisation and this case will not be further analysed here.

[26] In appendix 6.4 and 6.5 in Forslid and Okubo (2011), we calculate the "bifurcation point" at which relocation switches from the first to the second phase and the "sustain point" at which all industry has left Country 3.

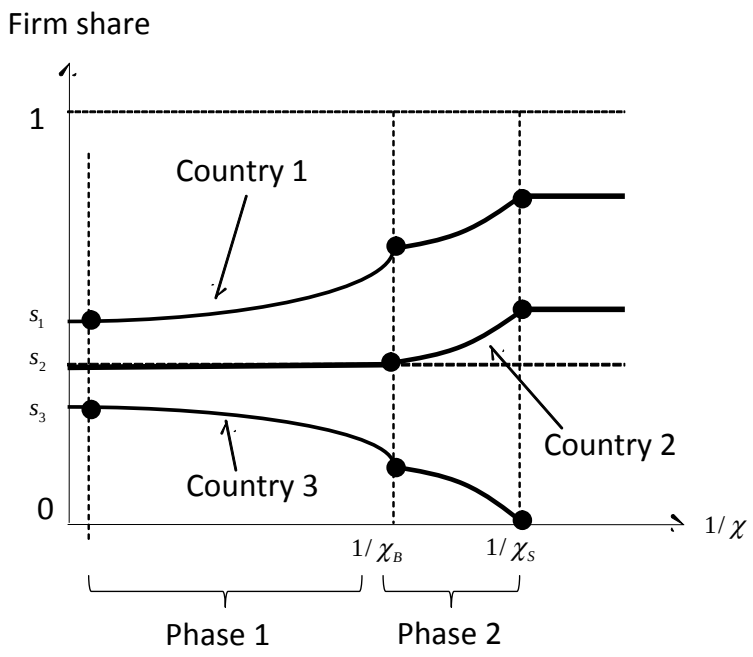

Figure 4: The effect of lower relocation costs.

increased welfare as trade costs are reduced, while a lower relocation cost leads to lower welfare as industry relocates. The intermediate country has increasing welfare in both cases, but gains industry as the relocation costs are reduced, while it loses industry as trade costs are reduced.

5 Concluding Discussion

This paper analyses a three-country trade and location model with heterogeneous firms, where the effects of trade liberalisation and a reduction of firm relocation costs are compared. Trade liberalisation eventually leads to agglomeration in the core, also in our case of multiple (three) countries and heterogeneous firms. However, this is no longer the case when considering the effect of lower relocation costs and multiple (three) countries. Unless the intermediate country is too small in relation to the other two countries, it will grow (as will the largest country) as a result of reduced relocation costs.

The welfare implications of trade liberalisation and reduced relocation costs also differ. Trade liberalisation leads to welfare gains for all countries even if both smaller countries lose their industrial base to the core. Reduced relocation costs instead imply loss of welfare and industry for the smallest country, but gains in welfare for the intermediate country, as long as it is sufficiently large to gain industry. This means that the interests of intermediate and small countries may be very different when it comes to these two types of economic integration policies.

Our model may be applied in a national context, where the policy experiments are regional policies, or it may be applied in an international context where the policy experiments pertain to different aspects of globalisation. First, from a regional policy perspective, the above experiments imply that it is of great importance how the integration of different regions in a country is achieved. Regional policy may involve policies that make it easier for individuals and firms to move between regions, such as less red tape or a better functioning real estate market, as well as policies that decrease transportation costs, such as better roads and trains. The first of these policies corresponds to a lower relocation cost in the model and the second to lower trade costs. From the perspective of the largest core region, these policies are both attractive as they lead to an increased concentration to the core and higher welfare. However, the interests of the two smaller regions differ. Lower relocation costs lead to higher welfare and more industry in the intermediate region (unless it is very small in a relative sense), whereas it leads to a loss of industry and welfare for the smallest region. Lower transportation costs lead to a deindustrialisation of the intermediate region along with the smallest one, while both regions gain in welfare.

Second, from an international perspective, our policy experiments imply that the development strategies of countries differ. In particular, the strategy may differ for very small countries and for countries of intermediate size. Intermediate size countries, as e.g. some of the fast growing Asian countries, may be best served by focusing on policies that facilitate the relocation of capital to the country, e.g. policies that promote inward FDI. The smallest developing countries

should instead focus on trade liberalisation according to our model.

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